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Language Characteristics of Individuals with Down Syndrome

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Abstract

On average, language and communication characteristics of individuals with Down syndrome (the most common genetic cause of intellectual disability) follow a consistent profile. Despite considerable individual variability, expressive language is more impaired than receptive language, with particular challenges in phonology and syntax. We review the literature on language and literacy skills of individuals with Down syndrome, with emphasis on the areas of phonology, vocabulary, syntax, and pragmatics. We begin by describing the hearing, oral-motor, cognitive, social, and prelinguistic and early nonverbal communication characteristics of individuals with Down syndrome. We conclude with a discussion of clinical implications and research directions.

KEY WORDS: Communication, Down syndrome, Language, Literacy, Neurodevelopmental Disorders, Speech

LANGUAGE CHARACTERISTICS OF INDIVIDUALS WITH DOWN SYNDROME

Despite considerable individual variability, individuals with Down syndrome have a characteristic profile of impairments in language and communication. Expressive language is typically more impaired than receptive language, and phonology, syntax, and some aspects of pragmatics are particular challenges. In this article, we review the research on phonology, vocabulary, syntax, pragmatics, and literacy skills of individuals with Down syndrome. We focus on receptive and expressive language in individuals of all ages. We begin by describing several foundations of language and communication development, including hearing, oral-motor, cognitive, social, and prelinguistic and early nonverbal communication skills. We conclude by describing implications for practice and directions for research.

Since Down syndrome is a genetic disorder, the following review is largely consistent with a categorical, medical model of language development. Accordingly, we aim to show how language and literacy competence may be affected by the cognitive-behavioral phenotype associated with a diagnosis of Down syndrome. However, we recognize the theoretical and practical importance of other prevalent models such as the social model, which stresses the role of social or environmental factors in language learning. Indeed, we consider social skills to be one of the foundations of language and communication development. Moreover, our sections on assessment and intervention are more socially-situated, with attention to family-centered and integrated service models. For further discussion of language development models, see Paul (2007), Hixson (1993), and Staskowski and Rivera (2005).

ETIOLOGY OF DOWN SYNDROME

Down syndrome is the most common genetic cause of intellectual disability, occurring in approximately 1 in 700 live births (Centers for Disease Control and Prevention, 2006). Ninety-

eight percent of cases of Down syndrome are caused by an extra copy of chromosome 21 (Trisomy 21). Translocation, occurring when part of chromosome 21 attaches to another chromosome, and mosaicism, occurring when some cells—but not all—include an extra copy of chromosome 21, are less common causes. A person of any race, socioeconomic status, or geographic location can have a child with Down syndrome. The only etiological factor undoubtedly linked to Down syndrome is increasing maternal age (Hassold & Sherman, 2002). See Patterson and Lott (2008) for further details about etiology.

FOUNDATIONS OF LANGUAGE AND COMMUNICATION

For all individuals, language and communication skills are related to skills in other areas. In this section, we review the literature on hearing, oral-motor, cognitive, social, and prelinguistic and early nonverbal communication skills of individuals with Down syndrome. The areas discussed represent a subset of domains that have a potential impact on language development. We chose to focus on these domains given their relevance for individuals with Down syndrome, the breadth of literature available for review, and limits on article length. However, our choice should not be construed as a claim that other areas are not important. For instance, problem-solving or attention can clearly have important effects on language and communication competence, even though they will not be covered in the section on cognitive skills.

Hearing skills

Approximately two-thirds of children with Down syndrome experience conductive hearing loss, sensorineural hearing loss, or both (Roizen, 2007). Hearing loss can affect one or both ears and range from mild to profound (Roizen, Wolters, Nicol, & Blondis, 1993). Otitis media is one cause of mild to moderate fluctuating conductive hearing loss when accompanied

by middle ear fluid. Children with Down syndrome may be particularly susceptible to otitis media, possibly due to narrow auditory canals and cranial facial differences seen in this population (Roizen, 2007). Otitis media was found by Shott, Joseph, and Heithaus (2001) to occur in 96% of young children with Down syndrome, with 83% requiring tympanotomy tubes. Whereas the association between early otitis media with effusion (OME) and language development is mild at best for typically developing children, OME-associated hearing loss may make children with Down syndrome more vulnerable since they are already at risk for language difficulties (American Academy of Pediatrics [AAP], 2004; Roberts et al., 2004). In fact, hearing loss is related concurrently to difficulties in comprehension of grammatical morphemes and vocabulary for individuals with Down syndrome (Miolo, Chapman, & Sindberg, 2005; Chapman, Schwartz, & Kay-Raining Bird, 1991). However, data on the early effects of OME on language development of children with Down syndrome are lacking. Longitudinal studies are needed to address the impact of OME during the early years of development on later language performance.

Oral-motor skills

Speech production of individuals with Down syndrome may be related to differences in oral structure and function (Miller & Leddy, 1998; Stoel-Gammon, 1997). Structural differences include a small oral cavity with a relatively large tongue and a narrow, high arched palate. Missing, poorly differentiated, or additional muscles characterize facial structures, and differences in nerve innervation have been found as well (Miller & Leddy, 1998). These differences are thought to account, in part, for poor speech intelligibility through dysarthric factors such as reduced speed, range of motion, and coordination of the articulators. In addition, compared with typically developing children, boys with Down syndrome show differences in the

structure of the lips, tongue, and velopharynx, and are less skilled at speech motor functions and coordinated speech movements involving the lips, tongue, velopharynx, and larynx (Barnes, Roberts, Mirrett, Sideris, & Misenheimer, 2006). Symptoms of childhood apraxia of speech have also been reported (Rupela & Manjula, 2007; Kumin, 2006; Kumin & Adams, 2000).

Cognitive skills

About 80% of individuals with Down syndrome have moderate intellectual disability, although some have severe intellectual disability and others have IQ scores in the average range (Pueschel, 1995; Roizen, 2007). Visuo-spatial processing and perception are generally accepted as relative strengths in individuals with Down syndrome (Fidler, Hepburn, & Rogers, 2006; Jarrold, Baddeley, & Hewes, 1999; Klein & Mervis, 1999). Although visual long-term memory appears to be impaired (Jarrold, Baddeley, & Phillips, 2007), this impairment may be restricted to visual-object learning tasks, and not extend to visual-spatial tasks (Vicari, Bellucci, & Carlesimo, 2005). Moreover, there is substantial evidence of verbal short-term memory impairments not explained by hearing loss or speech problems (Jarrold & Baddeley, 2001; Laws, 2002). Impaired phonological memory skills (measured with nonword repetition) may be related to poorer language comprehension, mean length of utterance (MLU), and reading in children and adolescents with Down syndrome (Laws, 1998, 2004).

Social skills

Social interaction is considered by many to be an important precursor to language acquisition. Social skills appear to be commensurate with mental age in the early development of young children (0-4 years) with Down syndrome (Dykens, Hodapp, & Evans, 1994). Children with Down syndrome are typically characterized as very social, engaging, and affectionate (Moore, Oates, Hobson, et al., 2002; Wishart & Johnston, 1990). In fact, socialization and daily

living skills appear to be relative strengths compared with communication (Dykens, Hodapp, & Evans, 2006; Fidler, Hepburn, & Rogers, 2006). Children with Down syndrome form interpersonal relationships in much the same way as typically developing peers (Freeman & Kasari, 2002), and adults appear to show lower aggression and antisocial behavior than other adults with learning disabilities (Collacott, Cooper, Branford, & McGrother, 1998).

However, social skills may be impaired for some individuals. Older studies indicate that at least 5%–7% of individuals with Down syndrome meet diagnostic criteria for autism (Ghaziuddin, Tsai, & Ghaziuddin, 1992; Kent, Evans, Paul, & Sharp, 1999). More recently, Hepburn, Philofsky, Fidler, and Rogers (2008) found that 15% of young children with Down syndrome met criteria for an autism spectrum disorder. Behavioral and psychiatric disorders, such as depression, appear to be less common in Down syndrome than in other types of intellectual disability; however, these difficulties may be more common in individuals with Down syndrome than in the general population (Antonarakis & Epstein, 2006; Roizen & Patterson, 2003). Moreover, social skills may decline and maladaptive behaviors increase with the onset of dementia in adults with Down syndrome ages 45 years and older (Urv, Zigman, & Silverman, 2008).

Prelinguistic vocal development and early nonverbal communication skills

The frequency and variety of consonants and vowels, as well as the age of onset of repeated consonant-vowel combinations (reduplicated, canonical babbling), are reportedly similar for infants with Down syndrome and typically developing infants (Dodd, 1972; Smith & Oller, 1981). The onset of canonical babbling, however, was delayed by about two months in another longitudinal study of children with Down syndrome (Lynch et al., 1995). Children with Down syndrome seem to use a comparable amount of gestures as language-matched children

(Iverson, Longobardi, & Caselli, 2003), although the communicative functions of the gestures may differ (Mundy, Kasari, Sigman, & Ruskin, 1995; Mundy, Sigman, Kasari, and Yirmiya, 1988). Specifically, Mundy and colleagues (1988) reported that 18–48 month-old children with Down syndrome produced fewer nonverbal requests for objects or help with objects, but not fewer indicating gestures (e.g., pointing to toys within reach, showing), than mental age-matched typically developing children. Moreover, more frequent nonverbal requesting may be associated with better expressive language development later, suggesting that language problems may have their origin in part in the prelinguistic period (Mundy et al., 1995).

LANGUAGE DEVELOPMENT

Expressive language skills are more impaired than receptive skills in young individuals with Down syndrome (Caselli et al., 1998; Chapman, Hesketh, & Kistler, 2002; Laws & Bishop, 2003). In this section, we describe the receptive and expressive language of children, adolescents, and young adults with Down syndrome in the areas of phonology, vocabulary, syntax, and pragmatics.

Phonology

In preschool and school-age children with Down syndrome, phonological errors are common. Although these errors resemble those made by younger typically developing children (Dodd, 1976; Rosin et al., 1988), inconsistency of errors may be characteristic of the phonological disorder in Down syndrome (Dodd & Thompson, 2001). Furthermore, children with Down syndrome continue to use phonological processes (systematic sound error patterns) for longer periods than typically developing children (Bleile & Schwartz, 1984; Dodd, 1976; Roberts et al., 2005; Smith & Stoel-Gammon, 1983; Stoel-Gammon, 1980). Based on a standardized test of single word articulation, Roberts and colleagues (2005) found that boys with

Down syndrome produced fewer consonants correctly and more syllable structure phonological processes (e.g., cluster reduction, final consonant deletion) than younger typically developing boys of similar nonverbal mental age. More recently, Barnes et al. (in press) reported similar findings for connected speech samples.

Young individuals with Down syndrome have poorer speech intelligibility than younger typically developing children of similar nonverbal mental age (Chapman, Seung, Schwartz, & Kay-Raining Bird, 1998; Barnes et al., in press). In fact, nearly all individuals with Down syndrome may be difficult to understand at least some of the time (Kumin, 1994). The phonological factors described above, in addition to factors such as apraxia of speech, dysarthria, and voice quality, may impact speech intelligibility. It is also possible that poor speech intelligibility affects productive language performance (Bray & Woolnough, 1988; Miller & Leddy, 1998), which could help to explain the discrepancy between expressive and receptive language seen in individuals with Down syndrome. For example, Bray and Woolnough (1988) reported that intelligibility decreased with increasing syntactic complexity for 11 children with Down syndrome. Perhaps using a simpler sentence structure and communicating mainly via key words is a more successful strategy for children with Down syndrome. See Price and Kent (2008) for more details about intelligibility in individuals with Down syndrome.

Vocabulary

Conflicting findings have been reported regarding the receptive vocabulary skills of individuals with Down syndrome. Several studies using standardized assessments suggest that children and adolescents with Down syndrome comprehend spoken words at levels similar to mental age-matched typically developing children (Chapman et al., 1991; Miller, 1995; Laws & Bishop, 2003). In one study, vocabulary comprehension even exceeded nonverbal cognitive

ability for adolescents and young adults with Down syndrome (Glenn & Cunningham, 2005). However, in several other studies, children with Down syndrome scored lower than younger nonverbal mental age-matched typically developing children on standardized measures of receptive vocabulary (Caselli, Monaco, Trasciani, & Vicari, 2008; Hick, Botting, & Conti-Ramsden, 2005; Price, Roberts, Vandergrift, & Martin, 2007; Roberts, Price et al., 2007). Future research should determine whether conflicting findings are due to the different measures used or to variations in the ages and possibly hearing status of participants.

The acquisition of first words is delayed in children with Down syndrome, and subsequent growth in early expressive vocabulary is slow compared with expectations for typically developing children (Berglund, Eriksson, & Johansson, 2001; Caselli et al., 1998; Mervis & Robinson, 2000). For example, only 12% of one year-old Swedish children with Down syndrome included in a large-scale survey study produced at least one word (Berglund et al., 2001). Ninety percent of three year-olds and 94% of five year-olds, however, produced one or more words (with 73% of five year-olds having 50 or more words).

There is some evidence that the productive vocabularies of adolescents with Down syndrome are similar to those of younger typically developing children matched for nonverbal mental age (Laws & Bishop, 2003). Still, children with Down syndrome scored lower than mental age-matched typically developing children on standardized assessments of expressive vocabulary in several studies (Caselli et al., 2008; Hick et al., 2005; Roberts, Price et al., 2007). Additionally, Chapman and colleagues (1998) found that children and adolescents with Down syndrome (ages 5-20 years) produced fewer total and different words during connected speech (conversation and narration) than nonverbal mental age-matched typically developing children. In summary, most evidence suggests that expressive vocabulary is delayed beyond expectations

for mental age in young individuals with Down syndrome.

Syntax

Syntax appears to be a particular linguistic challenge for individuals with Down syndrome; it is more impaired than vocabulary in both receptive and expressive domains (Abbeduto et al., 2003; Berglund & Eriksson, 2000; Chapman et al., 1991; Laws & Bishop, 2003; Berglund et al., 2001). Syntax comprehension skills of children, adolescents, and young adults with Down syndrome are lower than expected given nonverbal cognitive ability (Abbeduto et al., 2003; Caselli et al., 2008; Chapman et al., 1991; Joffe & Varlokosta, 2007; Laws & Bishop, 2003; Price et al., 2007; Rosin, Swift, Bless, & Vetter, 1988). Price and colleagues (2007) reported that a group of 45 boys with Down syndrome scored lower on comprehension of grammatical morphology (prepositions and bound morphemes) and syntax (e.g., active or passive voice, direct or indirect objects) than younger typically developing boys of similar nonverbal mental age. Moreover, syntax comprehension may be characterized by slower growth or decline in late adolescence and early adulthood (Chapman et al., 2002; Laws & Gunn, 2004).

There is considerable evidence of productive syntax deficits in young individuals with Down syndrome beyond cognitive level. The emergence of two-word combinations is delayed in children with Down syndrome (Iverson et al., 2003). Later on, children and adolescents with Down syndrome produce shorter and less complex utterances than typically developing children of the same nonverbal mental age (Caselli et al., 2008; Chapman et al., 1998; Price et al., 2008; Rosin et al., 1988). For example, Price and colleagues (2008) found that a group of 31 boys with Down syndrome produced less complex noun phrases, verb phrases, sentence structures, and less complex questions and negations during conversation with an examiner than younger typically

developing boys of similar nonverbal mental age. In addition, production of grammatical morphemes is impaired in individuals with Down syndrome compared to MLU-matched typically developing children (Eadie, Fey, Douglas, & Parsons, 2002; Hesketh & Chapman, 1998). Specifically, Eadie and colleagues (2002) reported that children with Down syndrome scored lower than typically developing children on tense (past tense *-ed*, third person singular *-s*, and modals) and non-tense (articles, present progressive *-ing*) morphemes. Importantly, unlike syntax comprehension, MLU and syntax complexity may not plateau for individuals with Down syndrome, but may continue to grow into late adolescence and young adulthood, making expressive syntax a fertile area for intervention (Chapman et al., 2002; Thordardottir, Chapman, & Wagner, 2002).

Pragmatics

With the exception of requests, children with Down syndrome use the same variety of communicative functions (i.e., comments, answers, and protests) as younger typically developing children matched for language or developmental level (Beeghly, Weiss-Perry, & Cicchetti, 1990; Coggins, Carpenter, & Owings, 1983). Children with Down syndrome may stay on topic for a similar number of exchanges as mental age-matched children (Tannock, 1988), and for even more turns than younger MLU-matched children (Beeghly et al., 1990). On the other hand, some areas of pragmatics may benefit from intervention. Children with Down syndrome may initiate topics less often than younger mental age-matched children (Tannock, 1988). In addition, Abbeduto and Hesketh (1997) pointed out that measures of topic maintenance should not be limited to measures of topic length, which may contain minimal contributions, but also reflect the quality of contributions to the topic. More recently, Roberts, Martin, et al. (2007) reported that a group of 29 boys with Down syndrome were less elaborative when maintaining topics, and

produced more turns that were simply adequate in quality (e.g., simple responses and acknowledgments), than younger typically developing boys of similar nonverbal mental age.

Adolescents with Down syndrome may be less likely than typically developing children of the same mental age to signal noncomprehension of another's message. Abbeduto et al. (2008) found that adolescents with Down syndrome signaled noncomprehension less often than typically developing children matched on nonverbal mental age during a task that required participants to request clarification or additional information. Adolescents and young adults with Down syndrome also provided less clear messages describing novel shapes during a non-face-to-face task than mental age-matched typically developing children in another recent study (Abbeduto et al., 2006). However, responding to requests for clarification may be an area of strength. In one early study of four children with Down syndrome, Coggins and Stoel-Gammon (1982) found that all of them responded to all clarification requests in order to repair communication breakdowns.

Conveying the content of stories may be another relative strength for individuals with Down syndrome when using visual supports. Boudreau and Chapman (2000) reported that children, adolescents, and young adults with Down syndrome (ages 12-26 years) included a similar number of plot elements in their narratives of a wordless film as mental age-matched typically developing children. Moreover, young individuals with Down syndrome may recall more plot components and theme references than typically developing children matched on MLU or expressive language level (Boudreau & Chapman, 2000; Miles & Chapman, 2002). With only auditory presentation of stories, however, adolescents with Down syndrome recall less information than younger mental age-matched children (Kay-Raining Bird, Chapman, & Schwartz, 2004). This discrepancy in findings is likely related to the strengths in visual

processing discussed previously. Even with visual support, young individuals with Down syndrome use fewer cohesive devices (“intersentential connections”) than mental age-matched children (but not fewer than language-matched children) (Boudreau and Chapman, 2000).

In summary, young individuals with Down syndrome display a complex profile of strengths and weaknesses in pragmatic aspects of language. Challenges may include initiation and elaboration of topics, initiation of communicative repairs, and some linguistic aspects of narratives. Strengths tend to include use of a variety of communicative functions, ability to stay on topic, responses to requests for clarification, and storytelling with sufficient content when visual supports are used.

LITERACY DEVELOPMENT

Little is known about the percentage of individuals with Down syndrome who learn to read and the level of mastery they achieve. Many are able to develop some degree of literacy with guidance and exposure (Byrne, MacDonald, & Buckley, 2002; Kay-Raining Bird, Cleave & McConnell 2000; Kay-Raining Bird, Cleave, White, Pike, & Helmkey, 2008; Shepperdson, 1994). However, because few individuals with Down syndrome master reading, most available evidence focuses on emergent skills, such as phonological awareness and single word-decoding.

Relationships between literacy, language, and cognition

The ability to extract meaning from text is dependent on the possession of lexical and syntactic knowledge (Catts & Kamhi, 1999). Consequently, oral language skills have been shown to predict performance on a variety of literacy measures in typically developing children (Paul, Murray, Clancy, & Andrews, 1997; Scarborough & Dobrich, 1994; Storch & Whitehurst, 2002) and in children and adolescents with Down syndrome (Boudreau, 2002). Therefore, receptive and expressive language impairments are likely to extend to reading and writing skills.

In children and adolescents with Down syndrome, receptive vocabulary skills predict performance on both word attack (phonological decoding) and word identification measures (Kay-Raining Bird et al., 2000) and measures of written language (Kay-Raining Bird et al., 2008). The relationship between language and literacy may be bi-directional; some evidence suggests that literacy acquisition may foster language development in children with Down syndrome by playing to their relative visual strengths (Buckley, 2003; Laws, Buckley, Bird, MacDonald & Broadley, 1995; Laws & Gunn, 2002). For example, Laws and Gunn (2002) found that early word reading skills of individuals with Down syndrome significantly correlated with MLU five years later.

Cardoso-Martins, Peterson, Olson, and Pennington (2009) administered a variety of reading measures (including single word recognition, reading comprehension, pseudoword reading accuracy, and single word spelling) to 20 adolescents with Down syndrome and found that average reading ability was lower than what would be predicted by IQ, although skill level varied among participants. However, other evidence suggests that children with Down syndrome have reading abilities above expectations given cognitive ability. Byrne, Buckley, Macdonald and Bird (1995) found that a group of 24 children with Down syndrome performed significantly more poorly on IQ measures compared with typically developing children matched on reading age. In other words, the children with Down syndrome were at the same reading level as younger typically developing children, despite significantly lower IQ scores.

Emergent literacy skills

Emergent literacy skills, and word identification skills in particular, have been identified as a relative strength for individuals with Down syndrome. In fact, not only do young individuals with Down syndrome perform similarly on measures of print, letter sounds, and letter

identification as mental age-matched typically developing children, they perform significantly better on word identification tasks (Boudreau, 2002). Moreover, they perform significantly better than reading-matched typically developing children on frequent-word reading tasks (Cardoso-Martins, Michalick, & Pollo, 2002). This relative strength in word identification may be a function of individuals with Down syndrome being older than typically developing children and therefore having had more exposure to common words (Fidler, Most & Guiberson, 2005).

Strength in word identification has been linked to whole-word reading processes in individuals with Down syndrome. When compared with typically developing reading age-matched children (matched on number of words read correctly and rapidly), individuals with Down syndrome perform similarly on tasks requiring recognition of orthographic patterns, but perform more poorly on nonword reading tasks, suggesting that individuals with Down syndrome rely on whole-word (versus phonological) processes in word-decoding (Verucci, Menghini, & Vicari, 2006). Whole-word versus phonological reading has been much debated in Down syndrome literacy research. The hypothesis that children with Down syndrome rely on whole-word processes to decode words was first introduced by Buckley (1985). This hypothesis has since been well-documented (see Boudreau, 2002; Cardoso-Martins et al., 2002; Fidler et al., 2005) and is appealing from a theoretical perspective in that strengths in visuo-spatial memory may facilitate whole-word processing. In fact, word identification is positively associated with visual processing skills in children and adolescents with Down syndrome, even after controlling for chronological age (Fidler et al., 2005).

Phonological analysis skills

As visual processing strengths may aid whole-word recognition, weaknesses in phonological (auditory) memory are thought to hinder phonological decoding skills in this

population. Phonological memory predicts variation in reading ability above what can be explained by general cognitive ability (Fowler, Doherty & Boyton, 1995). Kay-Raining Bird and colleagues (2000) also found that phonological memory predicted word attack ability 4.5 years later in a small group of children with Down syndrome after controlling for chronological and mental age.

Phonological awareness skills, such as phoneme segmentation and rhyme awareness, are strongly correlated with the ability to “sound out” words (phonological decoding) in typically developing children (Scarborough, 1998) and children with Down syndrome (Boudreau, 2002; Cardoso-Martins, & Frith, 2001; Cossu, Rossini, & Marshall, 1993; Cupples & Iacono, 2000; Fletcher & Buckley, 2002; Gombert, 2002; Kay-Raining Bird et al., 2000; Snowling, Hulme, & Mercer, 2002). Several studies suggest challenges in phoneme and syllable segmentation, sound deletion, and rhyming for individuals with Down syndrome (Cossu et al., 1993; Fowler et al., 1995, Cardoso-Martins & Frith, 2001, Verucci et al., 2006). Still, reading skills in this population are stronger than would be predicted by phonological awareness skills, suggesting reliance on other processes in word identification tasks (Cossu et al., 1993, Kay-Raining Bird et al., 2000). It seems that individuals with Down syndrome are capable of utilizing and improving phonological-decoding for word identification (Cupples & Iacono, 2000; Kennedy & Flynn, 2003; Van Bysterveldt, Gillon, & Moran, 2006; Goetz, Hulme, Brigstocke, Carroll, Nasir, & Snowling, 2008). In fact, after controlling for chronological age and intellectual ability, phonological awareness is significantly related to reading and writing abilities in individuals with Down syndrome (Cupples & Iacono, 2000, Cardoso-Martins & Frith, 2001, Fowler et al., 1995).

Complex literacy skills

Few studies have focused on complex literacy skills in individuals with Down syndrome, although available evidence suggests difficulties with these advanced skills. Bryne and colleagues (2002) charted the literacy development of 24 children with Down syndrome over a two-year period. Although the children with Down syndrome made significant improvements in single-word reading, no change in reading comprehension was observed. Verucci and colleagues (2006) also found impaired passage comprehension in 17 individuals with Down syndrome, as compared to a typically developing control group matched on accuracy and speed of single word reading.

Summary

In conclusion, many individuals with Down syndrome are capable of achieving some level of literacy competence given instruction and exposure to print. Individuals with Down syndrome have relatively strong whole-word recognition skills, despite impairments in phonological awareness. Literacy deserves attention from researchers and clinicians, as even basic literacy skills can improve quality of life for individuals with Down syndrome by promoting communal and vocational independence (Miller, Leddy, & Leavitt, 1999).

LANGUAGE INTO ADULTHOOD

Compared with the research on young individuals with Down syndrome, fewer studies have characterized the language and communication of adults. In a review article, Rondal and Comblain (1996) concluded that morphosyntax and phonology continue to be relative weaknesses for adults with Down syndrome, with semantics and pragmatics being relative strengths. However, receptive and expressive morphosyntax and lexical skills may remain stable from late adolescence through at least about 50 years (Rondal & Comblain, 2002). Declines in pragmatic skills have been reported with the progression of suspected Alzheimer's disease, and

brain atrophy may also be associated with declines in receptive vocabulary (Nelson, Orme, Asann, & Lott, 2001). Fifty to seventy percent of adults with Down syndrome may evidence symptoms of Alzheimer's disease by 60-70 years of age (Zigman & Lott, 2007), and dementia has been found to be associated with declines in adaptive behavior for individuals with Down syndrome (Prasher & Chung, 1996). See Rondal and Comblain (1996) and Chapman and Hesketh (2000) for further details about language in adults with Down syndrome, and see Zigman and Lott (2007) for a review of Alzheimer's disease in Down syndrome.

CLINICAL IMPLICATIONS

The preceding review provides information regarding common language and communication characteristics of individuals with Down syndrome. Though an etiological category by itself may not be very helpful for directing clinical practice (Paul, 2007), awareness of the characteristic profile of strengths and weaknesses associated with a particular diagnosis may help a clinician to focus assessment and intervention efforts. Similarly, to maximize the usefulness of this short review, we have focused in this section on areas likely to benefit from intervention given the characteristic profile of language in Down syndrome. In practice, of course, clinical procedures should ultimately reflect the particular strengths and needs of clients and their families.

Assessment

Because middle ear problems and associated hearing loss are common among individuals with Down syndrome, routine screenings in these areas are recommended (Roberts et al., 2004). Hearing should be tested when OME lasts three or more months (AAP, 2004), following recommended procedures of the ASHA Audiologic Assessment Panel (1996). According to clinical practice guidelines, at-risk children may benefit from the use of tympanotomy tubes

when OME lasts longer than four months (AAP, 2004). In addition, speech and language should be monitored while OME is being medically managed. Amplification devices such as low gain hearing aids and classroom FM sound field systems may be helpful (ASHA, 2002). For additional strategies to optimize the language-learning environment for children with OME-related hearing loss, see AAP (2004), Roberts and colleagues (2004), and Roberts and Wallace (1997).

Each child with Down syndrome should have his or her language assessed to identify strengths and needs in phonology, vocabulary, syntax, pragmatics, and literacy. As with all children, families should be involved from the beginning of the assessment process. They can provide valuable information regarding child interests, general and medical history, interactions with siblings and other communication partners, and their own perspectives on strengths and needs (Crais, 1996; Crais, Roy, & Free, 2006; Hixson, 1993; Paul, 2007).

Given the common speech intelligibility and phonological problems of children with Down syndrome, speech production should be assessed in connected speech in addition to single words to determine sound accuracy and the occurrence of phonological processes. Importantly, speech assessment should focus on other potential causes of poor intelligibility such as oral-motor skills and vocal quality. In addition to instruments like the *Test of Language Development-3 Primary* (Newcomer & Hammill, 1997), which help a clinician to gain an understanding of a child's language skills across language components, the characteristic profile of language in Down syndrome supports the use of standardized tests that focus on particular areas. For example, results from the *Expressive Vocabulary Test 2* (Williams, 2007) for productive vocabulary and the *Structured Photographic Expressive Language Test 3* (Dawson, Stout, &

Eyer, 2003) for productive syntax and morphology may be useful with the aim of obtaining a detailed individual language profile.

Assessment of vocabulary and syntax should utilize a variety of language samples in addition to standardized measures. For example, narration may elicit more complex language (longer MLU, more word tokens, more word types) compared with conversation in individuals with Down syndrome (Chapman et al., 1998; Miles, Chapman, & Sindberg, 2006). Knowledge of the characteristic language challenges in Down syndrome, in addition to results from standardized testing, can inform a clinician's choice of areas to assess in-depth with language sampling. For example, computer-assisted language sample analyses such as the Systematic Analysis of Language Transcripts (Miller & Chapman, 2008) may be used to look at various aspects of productive syntax and morphology, an area of likely need for many children with Down syndrome. Pragmatic skills, particularly the ability to initiate topics, elaborate on topics, and initiate communicative repairs, may also be assessed from the conversation samples. Finally, language assessment should occur while the child interacts with a variety of communication partners (family, teachers, peers) and in a variety of contexts (home, classroom, community).

Literacy assessment should not be delayed until the school years, as foundational literacy skills begin to develop at birth, and early emergent literacy skills lay the foundation for more conventional forms of literacy. Assessment of early literacy skills can help to identify children who are at risk for difficulties with later, conventional literacy skills during the school years. Thus, early literacy assessment is essential.

Literacy assessment might include direct assessment of literacy skills (such as written language awareness, phonological awareness, letter name knowledge, grapheme-phoneme conversion, etc) or parent-reported measures, such as information regarding home literacy

practices or the child's literacy motivation. Assessment of the child's literacy environment, such as availability of books and writing materials and the availability of literacy role-models within the household can provide information regarding the child's given opportunities to develop foundational literacy skills.

Intervention

Language intervention for individuals with Down syndrome should aim to improve functioning in communication, academic, social, and vocational areas (ASHA, 2005). Prioritization of intervention targets should take into consideration family priorities, severity of the deficit, and importance for functionality in academic and social contexts (Crais, 1996; Dodge, 2004; McCauley & Fey, 2006; Paul, 2007). Knowledge of the cognitive-behavioral phenotype of Down syndrome, such as the neurocognitive profile and developmental trajectory, may also guide intervention practices (Fidler, 2005). For example, intervention strategies that capitalize on strengths in visual memory, such as the use of visually-oriented pictures and storybooks, may enhance learning in individuals with Down syndrome (Chapman, 2003; Hick et al., 2005; Roberts, Chapman, Martin, & Moskowitz, 2008).

Regardless of the particular intervention used, generalization of targeted skills should be considered from the beginning of any treatment program. Generalization is promoted by providing multiple opportunities to practice targeted skills in a variety of natural settings, such as the home, classroom, and community, and with a variety of communication partners, such as family members, teachers, and peers. Thus, collaboration among educators, speech-language pathologists, and families will be of utmost importance for treatment success. For more details about the intervention strategies that follow see Paul (2007) and McCauley and Fey (2006), and for specific information regarding integrated models of language intervention see Hixson (1993).

Target early communication

Early intervention is more effective than later intervention for young children with Down syndrome (Aparicio & Balana, 2002), even when intervention is delayed by only two months (Sanz & Menendez, 1996). Prelinguistic skills training and parent education may be effective interventions for young children with Down syndrome who produce few or no words.

Responsivity Education/Prelinguistic Milieu Teaching (RE/PMT) targets prelinguistic communication skills by teaching young children to use coordinated eye gaze, vocalizations, and gestures through prompting, arranging the environment, and teaching parents to be responsive to their children's verbal and nonverbal behaviors (Warren et al., 2006). For children with low rates of prelinguistic commenting and canonical vocalizations pre-treatment, RE/PMT improved rates of growth in prelinguistic commenting and lexical density, respectively, in one study that included 17 children with Down syndrome (39 children overall; Yoder & Warren, 2002).

However, RE/PMT improved rate of growth in requesting only for children without Down syndrome. Later, Fey et al. (2006) conducted a randomized clinical trial of 24-33 month-old children with developmental disabilities (26 of 51 with Down syndrome). Children who received six months of PMT used more intentional communication than controls, and having Down syndrome did not affect child outcomes. See Brady, Bredin-Oja, and Warren (2008) for further review of RE/PMT and other prelinguistic language interventions for young children with Down syndrome.

Target speech skills

For the child with Down syndrome who talks but is difficult to understand, speech intervention should target the specific phonological processes and sound errors that are problematic. Although speech intervention studies are greatly lacking, there is some indication

that the speech accuracy of young children with Down syndrome improves with parent-implemented treatment focusing on listening and production practice (Cholmain, 1994; Dodd, McCormack, & Woodyatt, 1994). Consistency of word production might be targeted before specific phonological targets in children with Down syndrome who show inconsistent error patterns (Dodd & Thompson, 2001). Given the common speech profile of individuals with Down syndrome, interventions that focus on the reduction of syllable structure processes (Hodson & Paden, 1991) may be successful in improving intelligibility. The cycles remediation approach (see Hodson, 2006; Hodson & Paden, 1991) may be particularly useful for highly unintelligible speakers. For individuals with Down syndrome who are severely unintelligible, initial treatment targets may include more functional vocabulary, such as words for basic needs and names of family members (Roberts, Stoel-Gammon, & Barnes, 2008). For specific strategies for improving speech production skills, see Bauman-Waengler (2004) and Smit (2004).

Target more complex language

Given that many individuals with Down syndrome have deficits in expressive syntax, syntax production is likely to be a focus of intervention. In fact, Chapman and colleagues (2002) argue that intervention goals should continue to address expressive syntax in adolescents and young adults with Down syndrome, as this area continues to develop into adulthood. In general, language input should be based on a child's receptive rather than expressive ability (Chapman et al., 1998). Speech-language pathologists can educate parents and teachers regarding the appropriate complexity of language based on results of the formal language assessment.

Conversational recasting is one method for developing complex syntax. In this approach, the child's utterance is reshaped by the communication partner (clinician, teacher, or family member) to include additional grammatical information. For example, if a child says "doggy

sleep,” the communication partner could elaborate “the doggy is sleeping.” (See Camarata and Nelson, 2006, for more details about the recast procedure.) The use of books that include repetitive examples of complex syntax has also been recommended (Roberts, Chapman et al., 2008), and may capitalize on relative strengths in visual processing. Clinicians may also utilize books to target developmentally appropriate expressive vocabulary, taking into account age-appropriate themes, academic and social needs, and current interests of the child (Roberts, Chapman et al., 2008). Moreover, partnering with teachers to identify key vocabulary from the curriculum will also be important for many children (Paul, 2007).

Pragmatic impairments such as the tendency to maintain a topic without adding additional meaningful information or the failure to initiate repairs to communication breakdowns are also important areas for intervention. Strategies to increase elaborative language include using topics and materials of interest to the child, allowing additional processing time, and using open-ended questions (Roberts, Chapman, et al., 2008). Individuals with Down syndrome may be taught to request clarification through the use of barrier games, in which the clinician intentionally gives unclear messages in order to create opportunities for the child to request clarification (Paul, 2007). Parents and teachers may also be educated to respond to all requests for clarification, so that such behaviors are naturally reinforced and more likely to continue.

Group treatment approaches that take place within the classroom (see Dodge, 2004, for specific suggestions) may succeed in improving pragmatic and other language skills by taking advantage of strengths in social interaction. For other strategies to develop complex language skills of individuals with Down syndrome across language domains, see Kumin (2008).

Target literacy skills

Historically, it was thought that children with Down syndrome would not benefit from phonological awareness instruction as a consequence of syndrome-specific impairments in phonological memory (see Jarrold, Baddeley & Phillips, 1999, for a review). As a result, a whole-word approach to literacy instruction has been recommended in the past (Hoddap & Fidler, 1999). An obvious weakness of this approach is that it does not explicitly teach strategies to decode untrained words. Fortunately, recent research suggests that children with Down syndrome are able to make improvements in phonological awareness skills (Kennedy & Flynn, 2003; Van Bysterveldt et al., 2006) and utilize phonological awareness skills to aid in word-decoding (Cupples & Iacono, 2000; Fidler et al., 2005). Cupples and Iacono (2002) found that children with Down syndrome who received phonological reading instruction generalized learning to untrained words, whereas children who received whole-word instruction did not. Therefore, despite known weaknesses in phonological memory, it seems that children with Down syndrome benefit from phonological skills training to support literacy acquisition.

More recently, it has been recommended that literacy intervention for children with Down syndrome should start with sight words (whole-word training) and then progress to include phonological awareness training (Buckley, 2003; Cupples & Iacono, 2002; Goetz et al., 2008; Oelwein, 1995). This holistic approach has also been supported for children with reading delays (Hatcher, Hulme, & Ellis, 1994; Hatcher, Hulme, Miles, Carroll, Hatcher, & Gibbs, 2006; Hatcher, Hulme, & Snowling, 2004). Intervention strategies for this population should use strengths in whole-word recognition to foster the development of phonological decoding skills. For example, frustration could be avoided by introducing phonological training with word sets that the child is already able to decode using whole-word processes. Also, activities can be designed to emphasize phonological patterns in word sets with which the child has had previous

success. For example, if the child has had whole-word decoding success with several words that begin with the phoneme /p/, targeting these words as a group and emphasizing their phonological similarity may raise the child's phonological awareness, as well as serve as a confidence-building activity.

Later, intervention may target advanced literacy skills such as passage comprehension. Playing to the visual strengths seen in Down syndrome may reduce frustration when targeting advanced literacy skills. For example, a lesson aimed at improving plot structure knowledge or narrative comprehension might incorporate illustrations to support written text. Additional research is needed to evaluate the efficacy of specific intervention tactics. For further review and details about approaches to develop literacy skills in individuals with Down syndrome, see Buckley and Johnson-Glenberg (2008).

Consider augmentative or alternative communication

Augmentative or alternative communication (AAC) systems, such as sign language, visual schedules, pictures, object symbols, or computerized speech production devices, may improve the communicative competence of individuals with Down syndrome who are delayed in speech onset or have markedly reduced speech intelligibility. In fact, children with Down syndrome commonly use sign language to communicate (Kumin, 2003), and there is general agreement that AAC use does not hinder the development of spoken language but may actually promote its development (Brady, 2008; Millar, Light, & Schlosser, 2006). Moreover, the use of AAC systems could facilitate access to books and literacy experiences for some users. See Brady (2008) for more details about AAC use with individuals with Down syndrome.

CONCLUSION

Despite considerable individual variability, the language and communication characteristics of individuals with Down syndrome follow a common profile. Expressive language is typically more impaired than receptive language, and syntax is more impaired than vocabulary. There is strong evidence that phonology, expressive vocabulary, receptive and expressive syntax, and some pragmatic aspects of language are impaired beyond expectations for nonverbal cognitive level. Specifically, syllable structure phonological processes, such as cluster reduction and final consonant deletion, appear to be common in children with Down syndrome. Children and adolescents with Down syndrome produce shorter and less complex utterances than would be expected based on nonverbal mental age, although advances in syntax complexity may continue into late adolescence and young adulthood. They also may have difficulty initiating and elaborating on conversational topics, and initiating repairs of communicative breakdowns. These areas of impairment coexist with areas of relative strength, such as the ability to stay on conversational topic, content-related narrative skills, and the ability to respond to requests for clarification in order to repair communicative breakdowns. This pattern of relative strengths and weaknesses remains apparent in adulthood. Later on, dementia in older adults with Down syndrome may compromise various aspects of language and communication. Many individuals with Down syndrome can achieve some level of literacy competence given exposure and instruction. In fact, individuals with Down syndrome have relatively strong whole-word recognition skills (yet impaired phonological awareness skills). Intervention that is appropriate to each individual's profile and reflects family priorities should begin early and continue throughout adolescence and adulthood.

Future research should continue to clarify the language profile of individuals with Down syndrome. For example, it will be important to examine whether discrepant findings for

receptive vocabulary relate to differences in method of assessment, ages of participants, or hearing status (current or early) of participants. Future analyses should follow children longitudinally, examining whether language skills change over time and which factors predict change. The preceding review of the literature identified several underlying factors of language development in individuals with Down syndrome. For example, hearing loss has been shown to be related to difficulties in comprehension of grammatical morphemes and vocabulary (Miolo et al., 2005; Chapman et al., 1991), phonological memory to language comprehension, MLU, and reading (Laws, 1998, 2004), and nonverbal requesting to later expressive language development (Mundy et al., 1995). Future studies should continue to investigate predictors of language and communication in individuals with Down syndrome, paying attention to other cognitive (e.g., attention) and social (e.g., autistic characteristics, communication partner interaction style) aspects of development. Finally, well-designed intervention studies are needed to determine the efficacy of commonly recommended approaches for developing language and literacy, with attention to outcomes in communication as well as academic and social domains.

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